Activity #7

Title: Detecting the Invisible- Student's Copy

Purpose:

- To be able to predict the color of light transmitted through various gels (filters).
- To demonstrate that an invisible energy (infrared) is located beyond the red band in the visible light spectrum.

Materials Needed: Solar Cell, Amplified Speaker, Audio Cable, 1" Alligator Insulated Test/Jumper Cable Set, Diffraction Grating (holographic), Red and Green GamColor filters, 9 V battery, wire nuts, Overhead projector, and Masking tape

The Photocell Detector used in this activity:

Photo #1

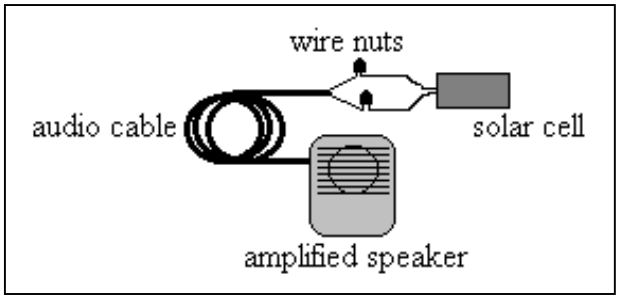

Photo #1A

The photocell (solar cell) produces an electric current when it is exposed to light. This electric signal is sent to the amplified speaker and creates one "pop." If the light signal is "chopped," the speaker produces a series of pops. If the light source is chopped very rapidly (as with a large-bladed fan placed between the light source and the solar cell), a hum is produced by the speaker. A constant source of light (such as from a flashlight) produces no noticeable sound on the speaker, but a pulsing light source (like the fluorescent overhead lights in most classrooms which "pulse" approx. 120 times per sec.) creates a continuous hum on the speaker. Passing your hand between a flashlight pointed at the solar cell produces one pop. Rapidly moving your hand back-and-forth in the beam of light will produce a series of pops that should be audible throughout the entire classroom.

Procedure/Inquiry: Part I

1. Your teacher will shine a flashlight (**in a darkened room**) on the photocell attached to the amplified speaker. Describe what you hear.

2. Describe what you hear when the teacher moves a hand through the beam of light entering the solar cell.

3. When the teacher moves a hand rapidly back and forth through the beam of light that enters the photocell, describe what you hear.

4. Explain what must happen in order to be able to "hear" light energy. Be sure to include the components necessary to perform this task successfully.

5. Your teacher will now project a slit of light from the overhead projector through a diffraction grating and onto the classroom screen or wall. Describe the image that appears on the screen.

6. How is this image different than the one produced when a slit of white light was passed through a prism? (Remember Activity #5?)

7. Now place a strip of masking tape above the image on the screen and mark the location of the red, yellow and green bands of light. Doing this will ensure that the projector, the diffraction grating and the screen remain in the same position throughout this activity. Describe what you hear when the teacher holds the photocell (with amplified speaker connected) in the red, the yellow and the green bands of the image while passing a hand through the incoming beam of light.

8. Predict what you will hear, if anything at all, when the photocell detector is held in the dark region to the immediate right of the red band of visible light.

9. After placing the detector in the dark region beyond the red band of visible light and chopping the beam with a hand, you can now determine: Was your prediction correct?

10. How do you know that some form of energy must be present in the region beyond the red band on the spectrum?

11. If this invisible energy is "beyond the red" portion of the visible spectrum, what do suppose it is? (Think back to Activity #4 involving the electromagnetic spectrum!) Explain your response.

Procedure/Inquiry: Part II

1. Predict what will appear on the screen when a red gel (filter) is placed between the diffraction grating and the screen. (Remember "Activity #6-Observing Colors?")

2. Now state what actually did appear on the screen with the red filter in place.

3. Predict what will appear on the screen with a green filter held between the diffraction grating and the screen.

4. What was actually observed after placing the green filter as described above?

5. Predict what will appear on the screen when BOTH the red and green filters are placed between the grating and the screen.

6. With both gels in place as described above, tell what appeared on the screen.

7. Do you think that the photocell detector will produce a popping sound when held (and the incoming beam "chopped" by one's hand) in the regions on the screen where the red, green and yellow were originally displayed? **Note:** The red and green filters are still in place between the diffraction grating and the screen.) Why or why not?

8. What did you hear when the photocell detector was held in the visible light sections of the display on the screen?

9. Predict what you will hear (with the red and green gels in place) when the photocell detector is held in the dark region beyond (to the right) of the red band location on the screen.

10. Was any popping actually heard when procedure #9 was performed?

11. What does this tell you about the ability of this "invisible light" beyond the red band of the spectrum to pass through filters (gels)?

12. Tell why you think it may or may not be possible for this invisible light to exist in rainbows?

Technology Integration: The following websites contain activities and resources to enhance the understanding of the scientific principles encountered in this teacher demonstration.

- http://physics.nm.ru/Physics/English/DG10/theory.htm Basic theory of diffraction gratings
- http://www.matter.org.uk/schools/Content/Interference/gratings.html Interactive program which allows the user to vary the number of slits in a diffraction grating
- http://fusioned.gat.com/Teachers/Curriculum/Curriculum-HTML/T04S-wavelength.html Measuring the wavelength of light using a diffraction grating
- http://www.homeschoolscience.com/sample_lessons/sample_light.html Diffraction glasses (eyewear) and simple inquiry activities
- http://www.geom.umn.edu/education/calc-init/rainbow/experiment.html Explains the reflection of light within raindrops to produce the rainbow
- http://www.chennaionline.com/science/rainbow.asp How rainbows are formed